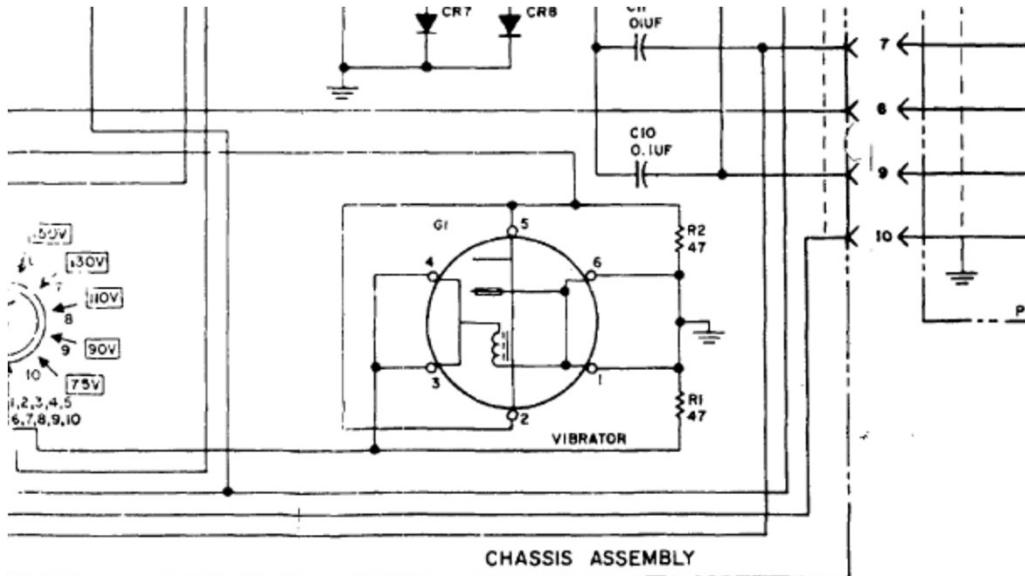


Service Log AN/GRC-109 communication system
PP2684/GRC109 rebuild
26-Dec-2019, Virgil Cheng vr2xgm

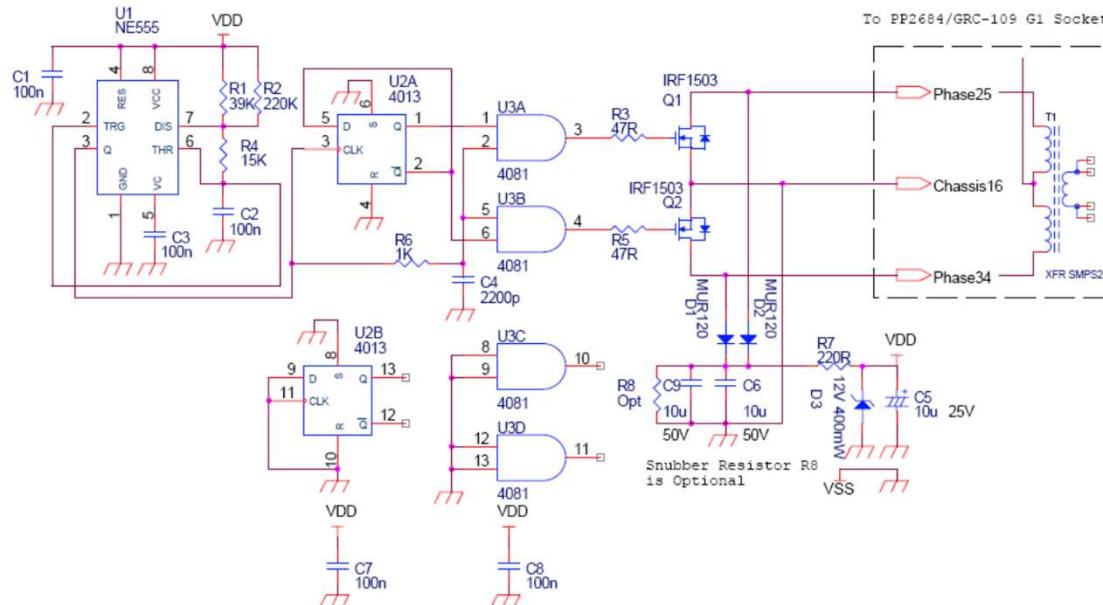
Power section service history:

- Vibrator G1 had contact problem, was replaced with a home built electronic unit back in 11-Nov-2005

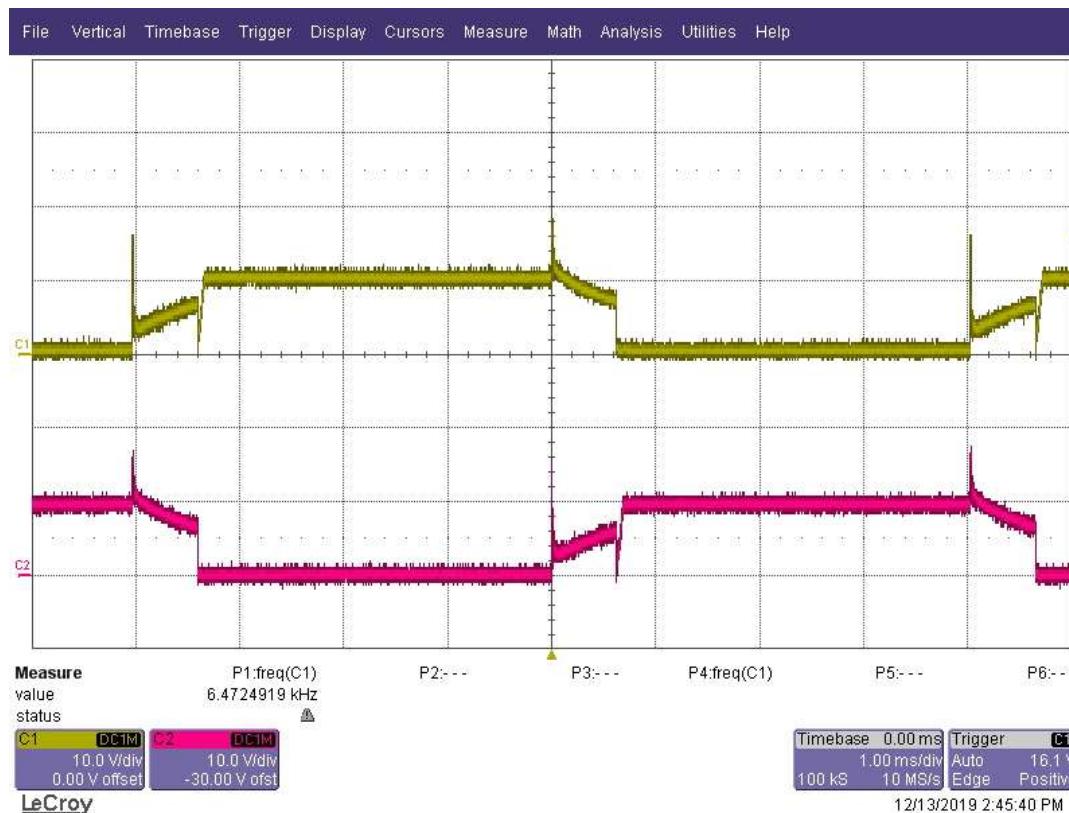
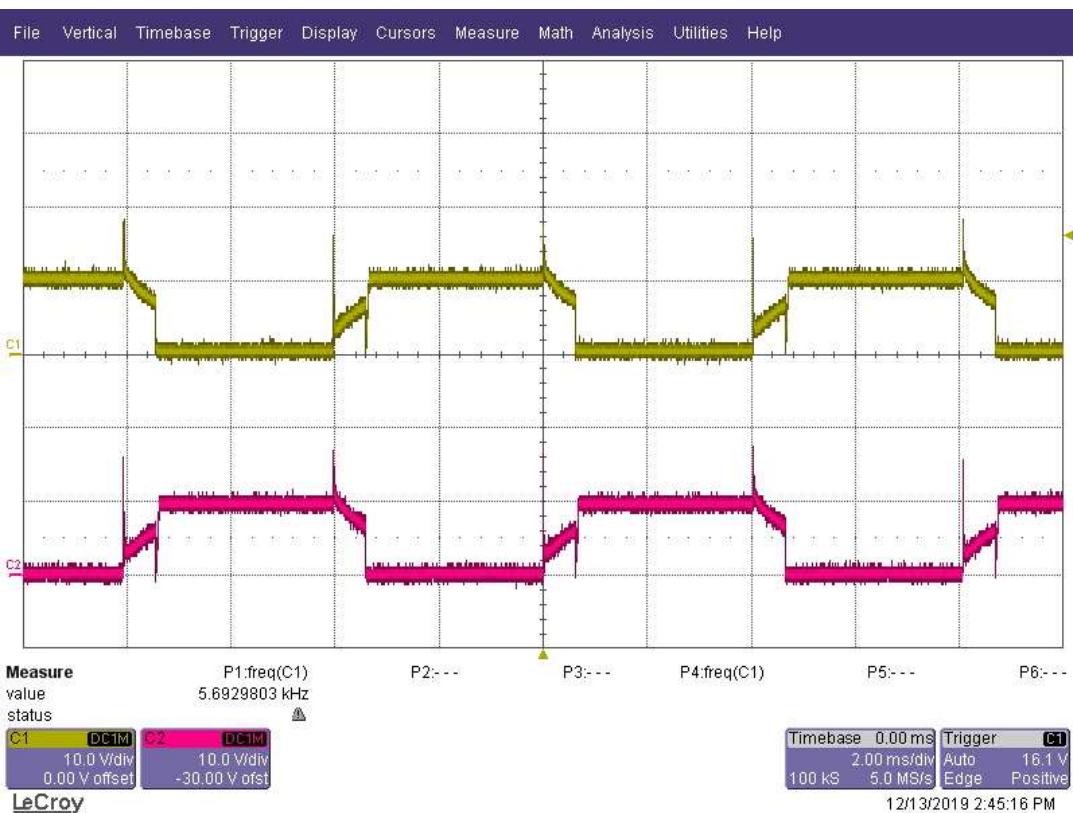


This VN-92C by Cornell-Dubilier was difficult to find, it was rebuilt with a solid-state replacement

Adjust R1//R2, R4 for 240Hz output
Adjust R4 for ~1mS deadtime



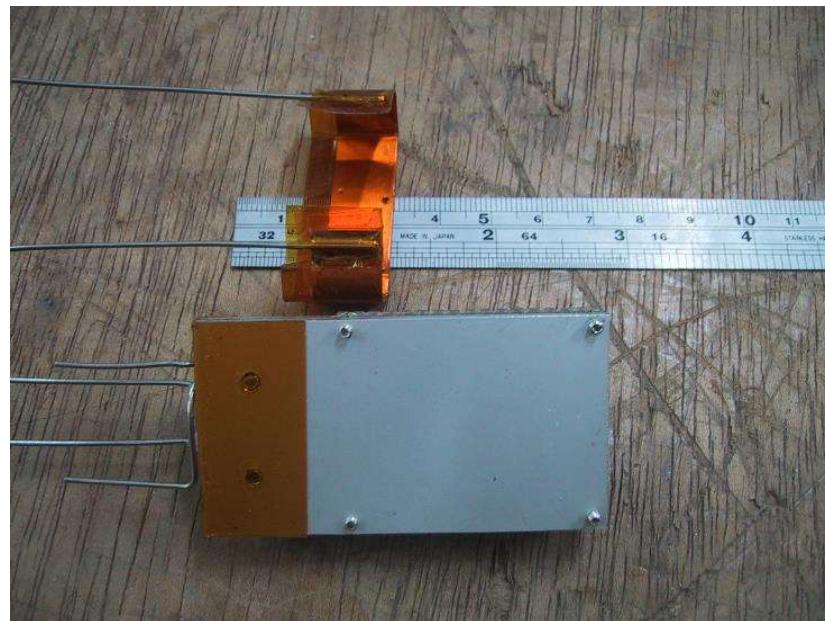
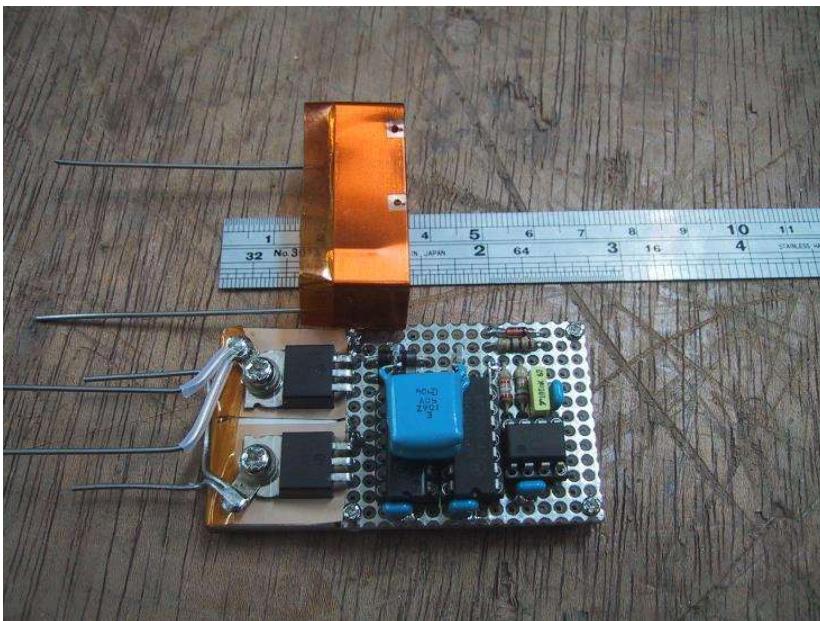
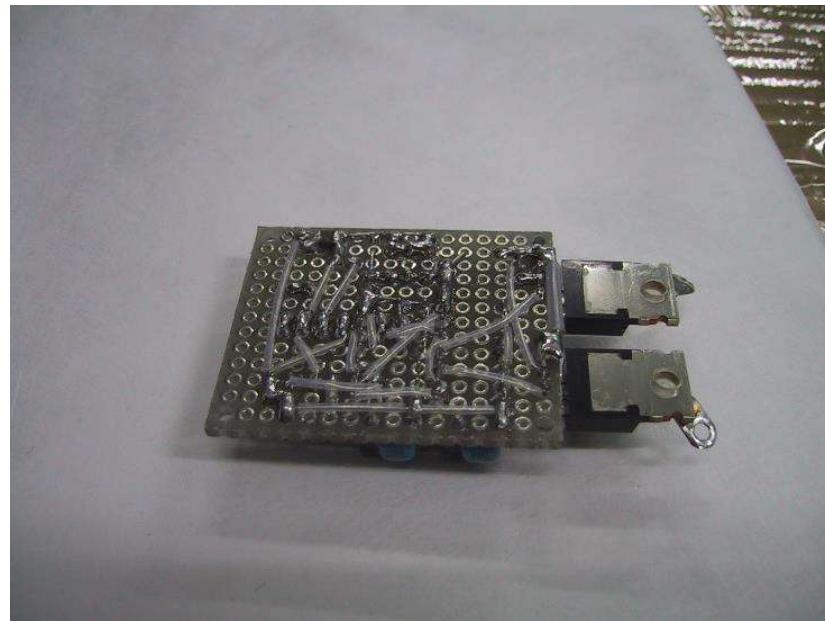
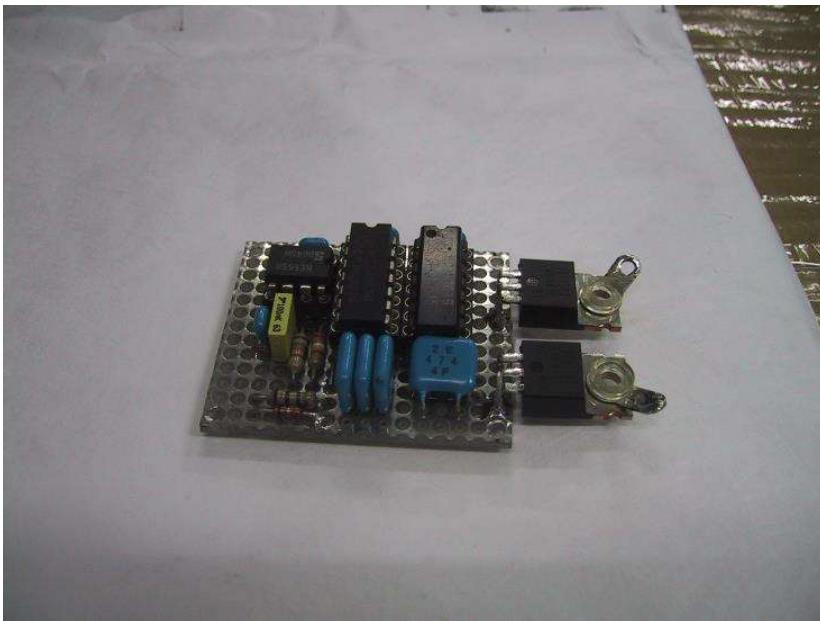
- U1 generates a 240Hz pulse with a 1mS logic '0' pulse width
- 1mS pulse doubles as deadtime for push-pull converter
- signal is fed to U2A to generate 120Hz switching frequency to match VN-92C frequency specification
- Output from U3A/B drives push-pull switched Q1 and Q2, are 30V 3.3mΩ MOSFETs
- D1/D2/R7/D3/C5 provide higher optimum circuit operating voltage once the push-pull section started up

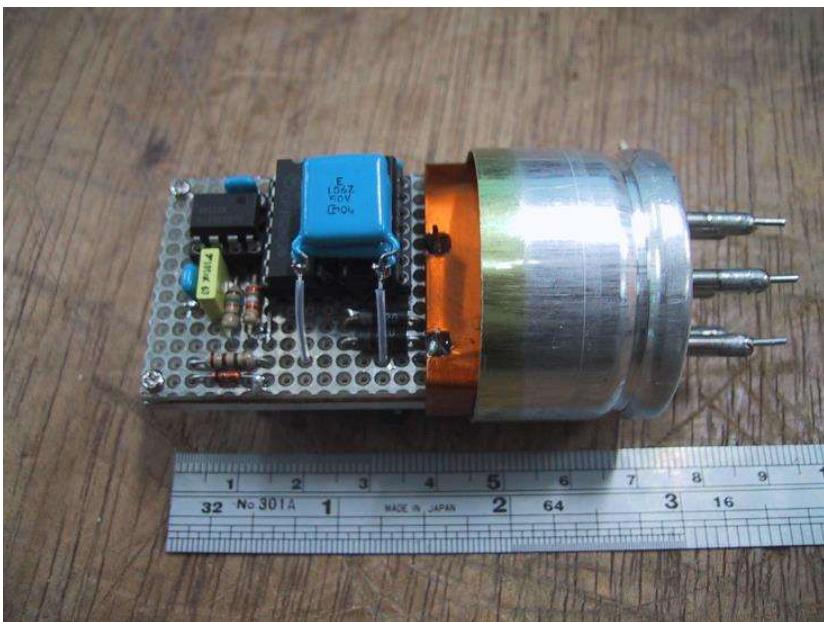
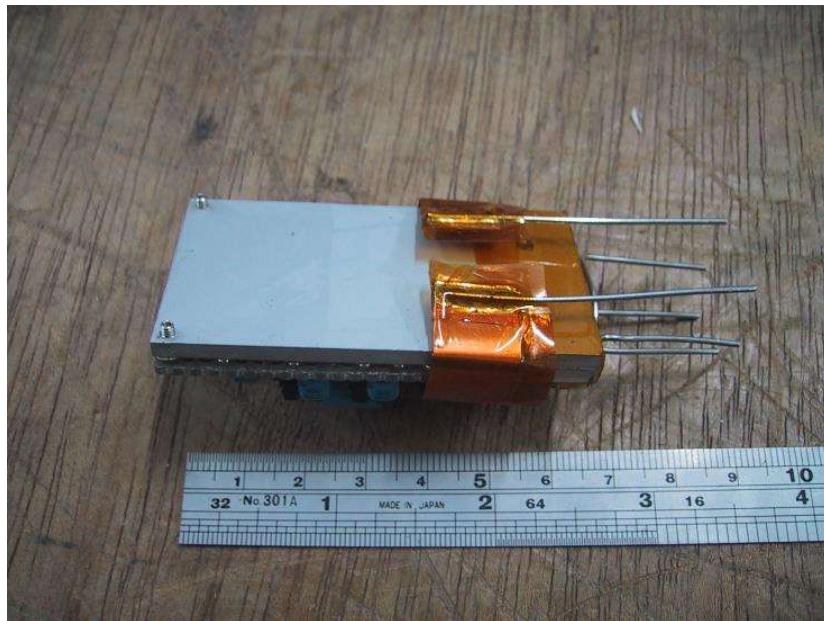
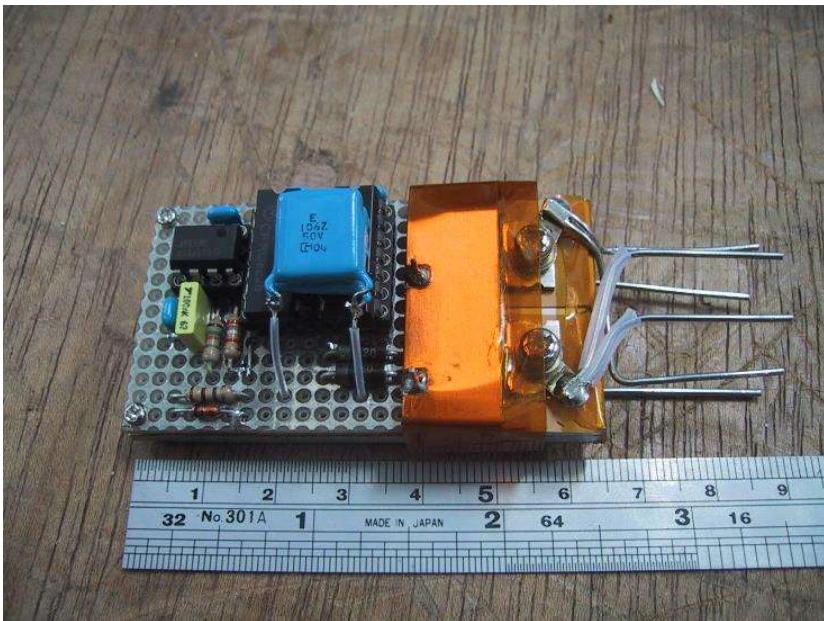


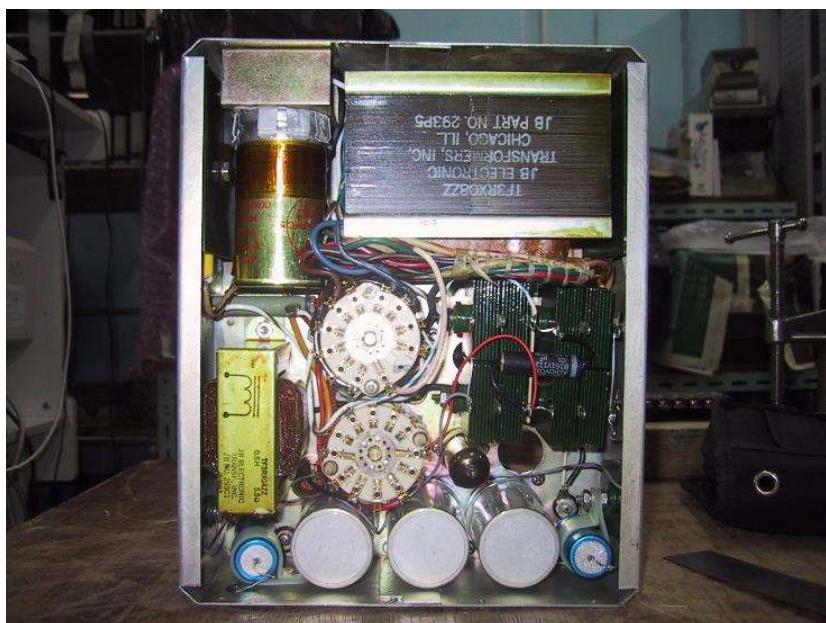
MOSFET Vds waveform, full load condition, added 13-Dec-2019



MOSFET Vds waveform, full load condition, spike closeup

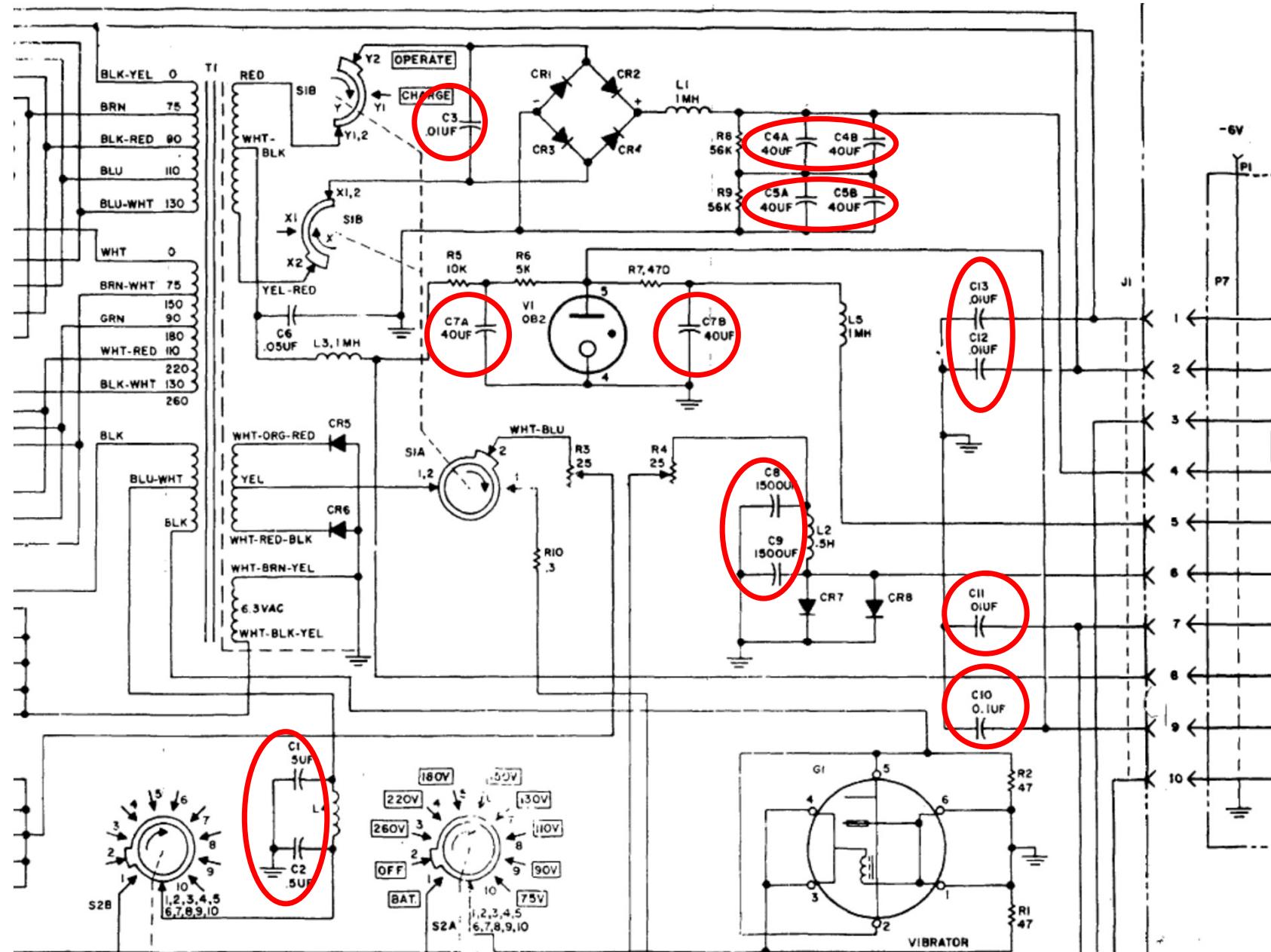




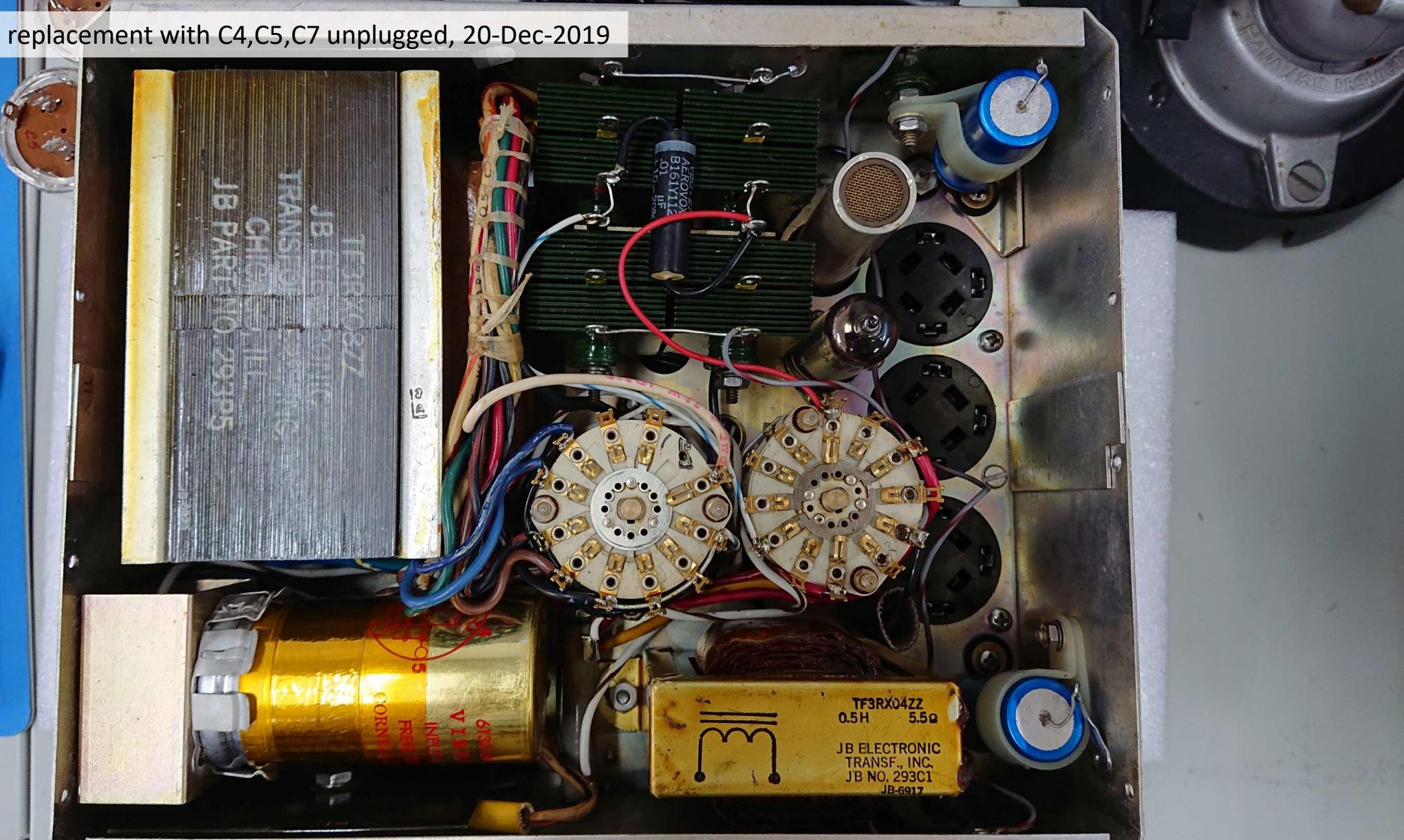


Dec-2019, Degraded components replaced

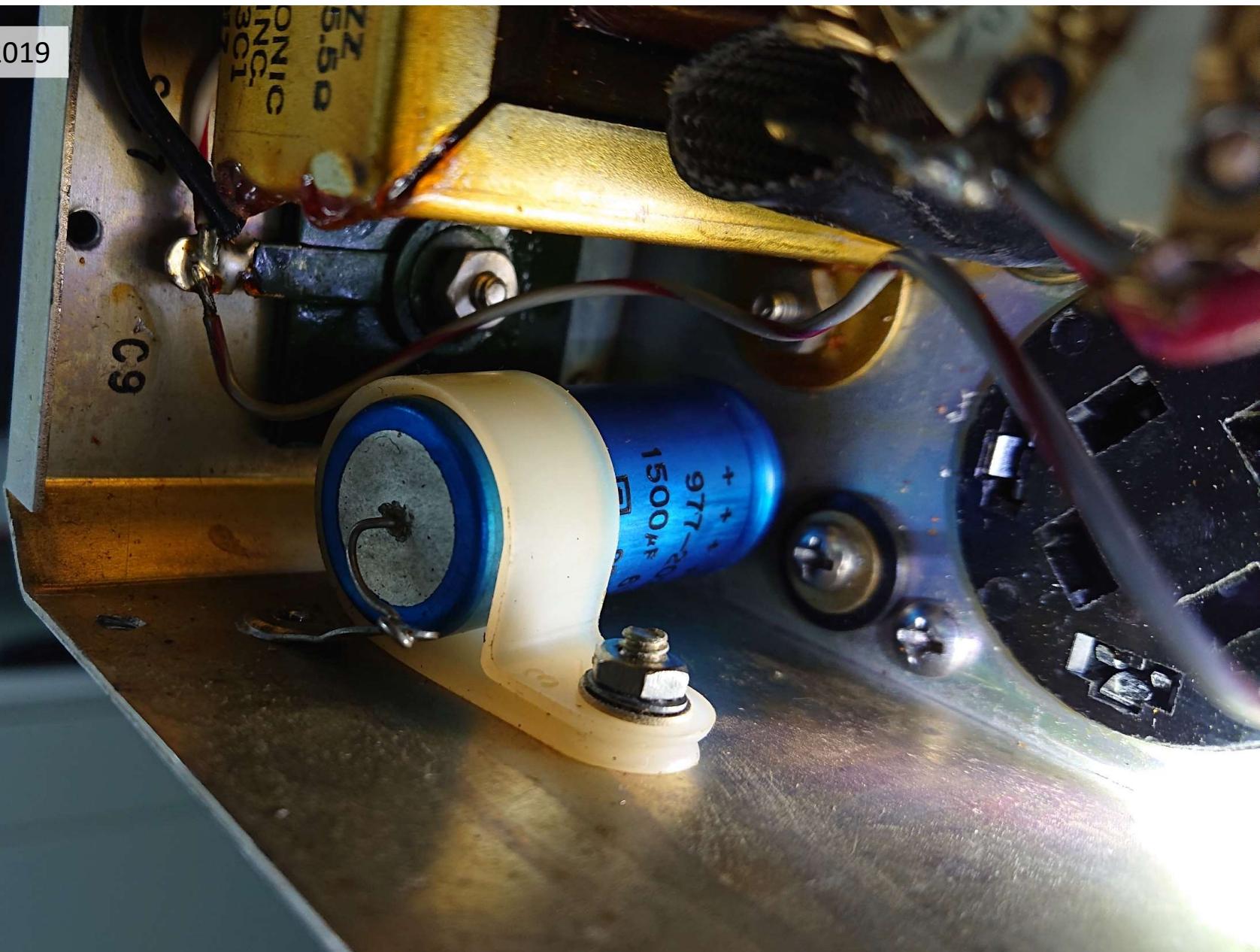
Legend	Description	Replaced with	Use at
C1,C2	Capacitors, film 0.5uF, 100V, Sprague Yellow Jacket	0.47uF, 630V, PP, Panasonic ECWFE	Vibrator push-pull circuit input filter
C3	Capacitor, film 0.01uF, 1600V, Aerovox VBC-27		High voltage winding termination capacitor
C4AB,C5AB	Capacitor, Elec, 40uF, 350V, 85°C dual	47uF, 400V, 105°C, Panasonic EE-A series, refill	High voltage smoothing filter, transmitter
C6	Capacitor, film, 0.05uF, 400V, Actual 0.47uF	0.47uF,PP, 630V, Panasonic ECWFE	High voltage filter, receiver
C7AB	Capacitor, Elec, 40uF, 350V, 85°C dual	47uF, 400V, 105°C, Panasonic EE-A series, refill	High voltage smoothing filter, receiver
C8,C9	Capacitor, Elec, 1500uF, 6V, 85°C	1500uF, 16V, 105°C, Panasonic FR-A series	Filament voltage decoupling
C10	Capacitor, film, 0.1uF, 400V, Aerovox V146XR	0.1uF, 630V, PP, Panasonic ECWFE	V1 voltage stabilizer hand crank generator decoupling
C11	Capacitor, film, 0.01uF, 400V, Aerovox V146XR	0.01uF, 630V, PP, EPCOS B32621	Transmitter 6V filament power decoupling
C12,C13	Capacitor, film, 0.01uF, 400V, Aerovox V146XR	0.01uF, 250VAC, PP, Y2, Iskra KNB2520 MKP	AC power line Y capacitors, upgraded with safety approved capacitors
C14		Not replaced	

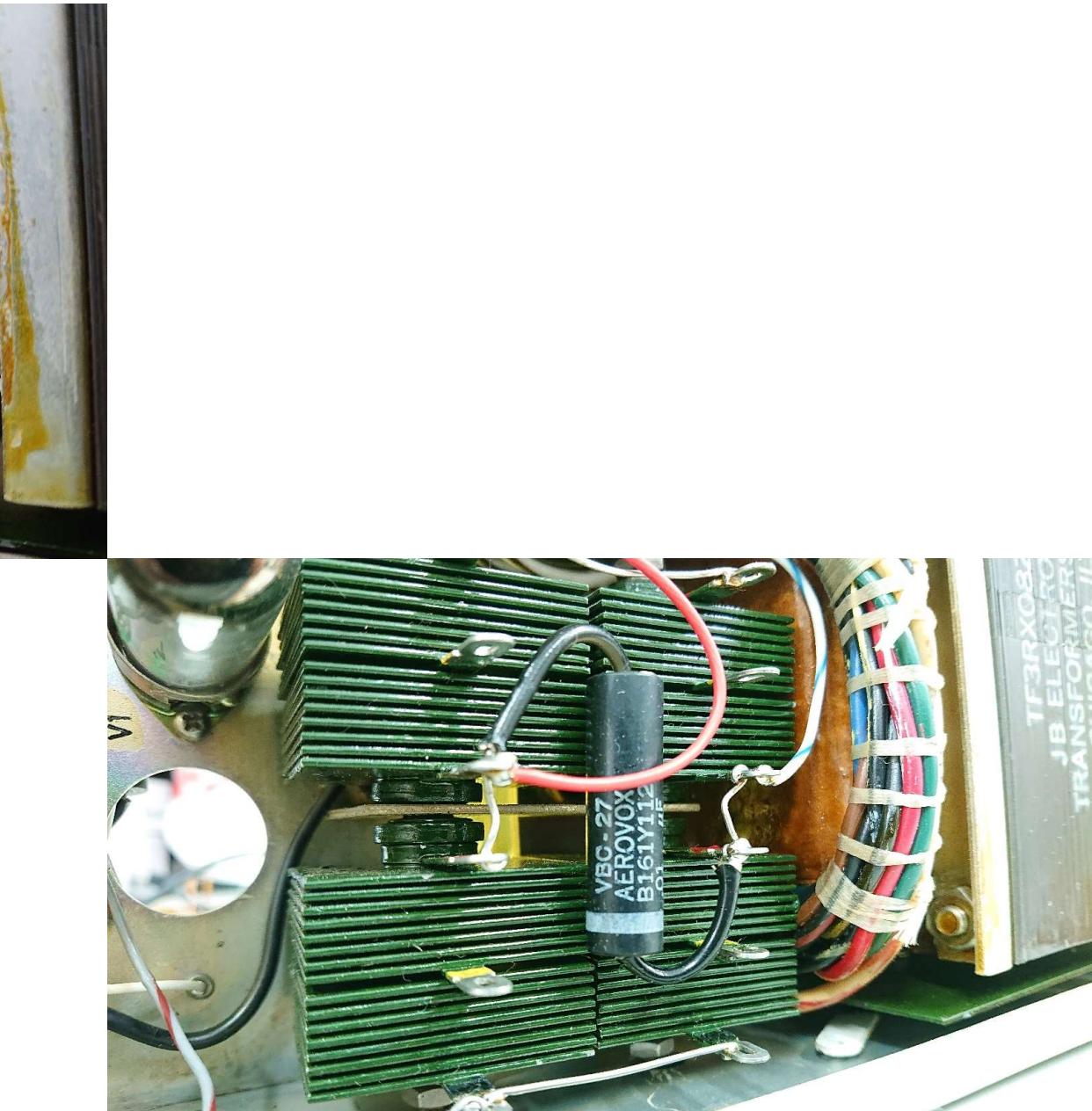
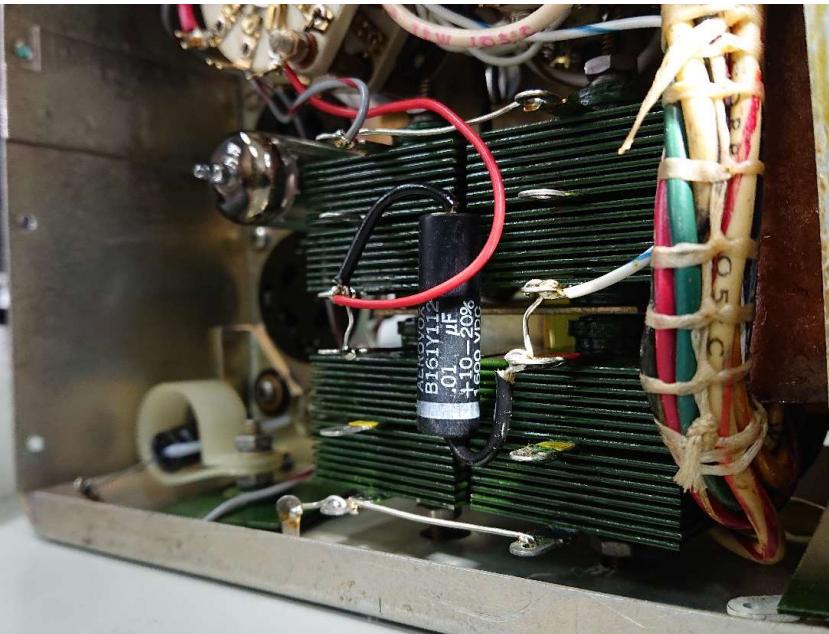


Before replacement with C4,C5,C7 unplugged, 20-Dec-2019



Before replacement , 20-Dec-2019





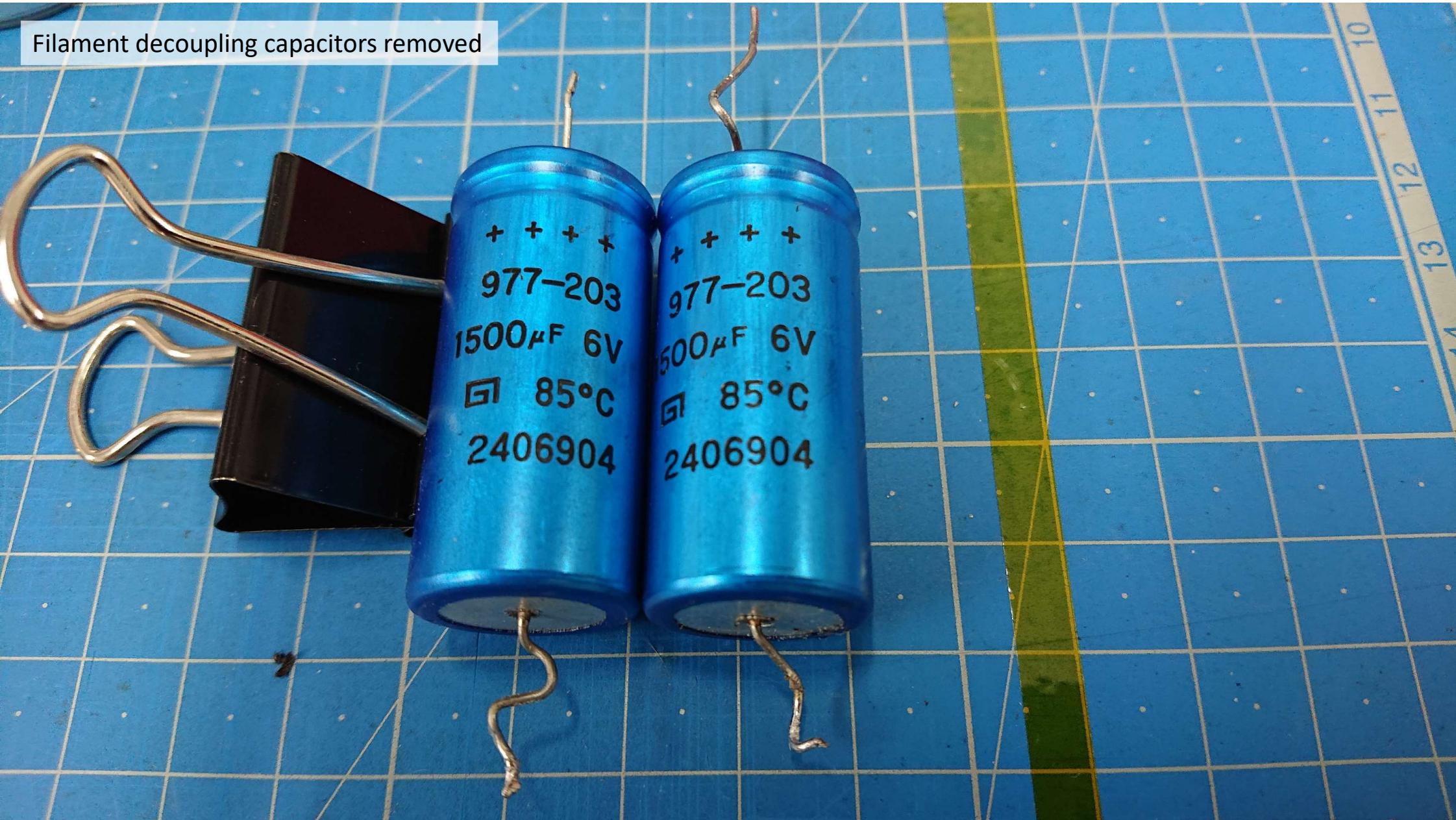
Before replacement C4,C5,C7 unplugged, 20-Dec-2019



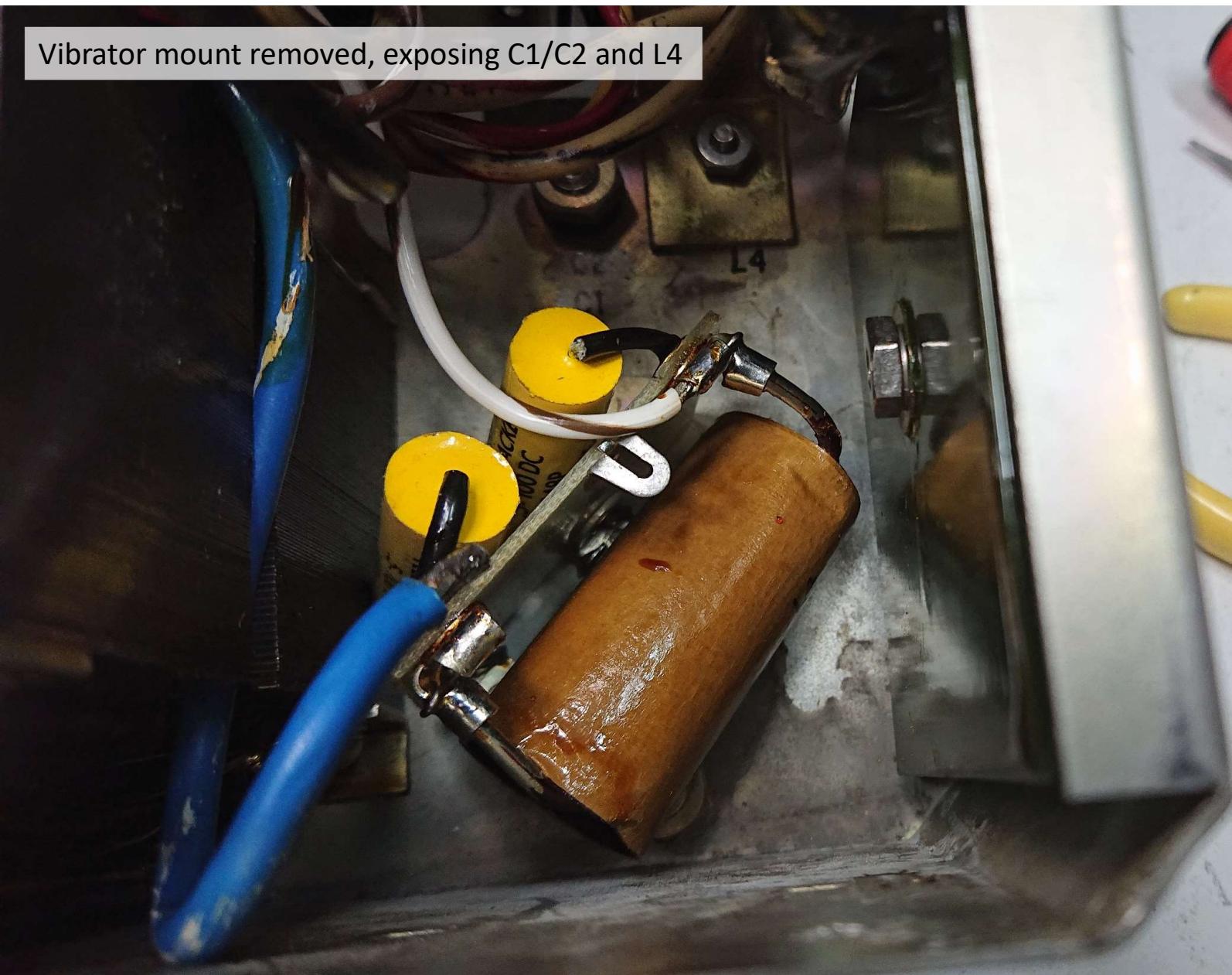
40uF 350V x2 capacitor opened



Filament decoupling capacitors removed



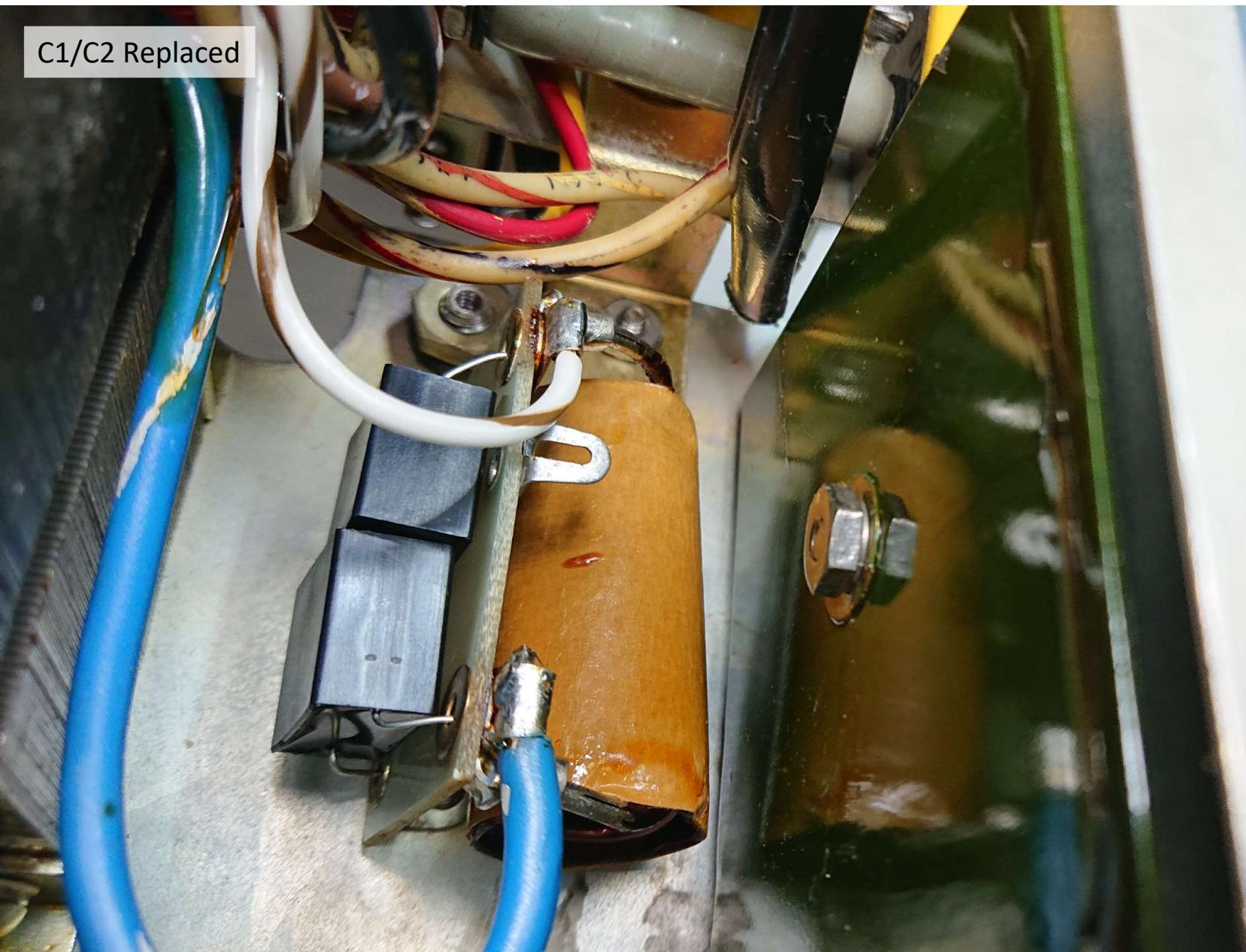
Vibrator mount removed, exposing C1/C2 and L4



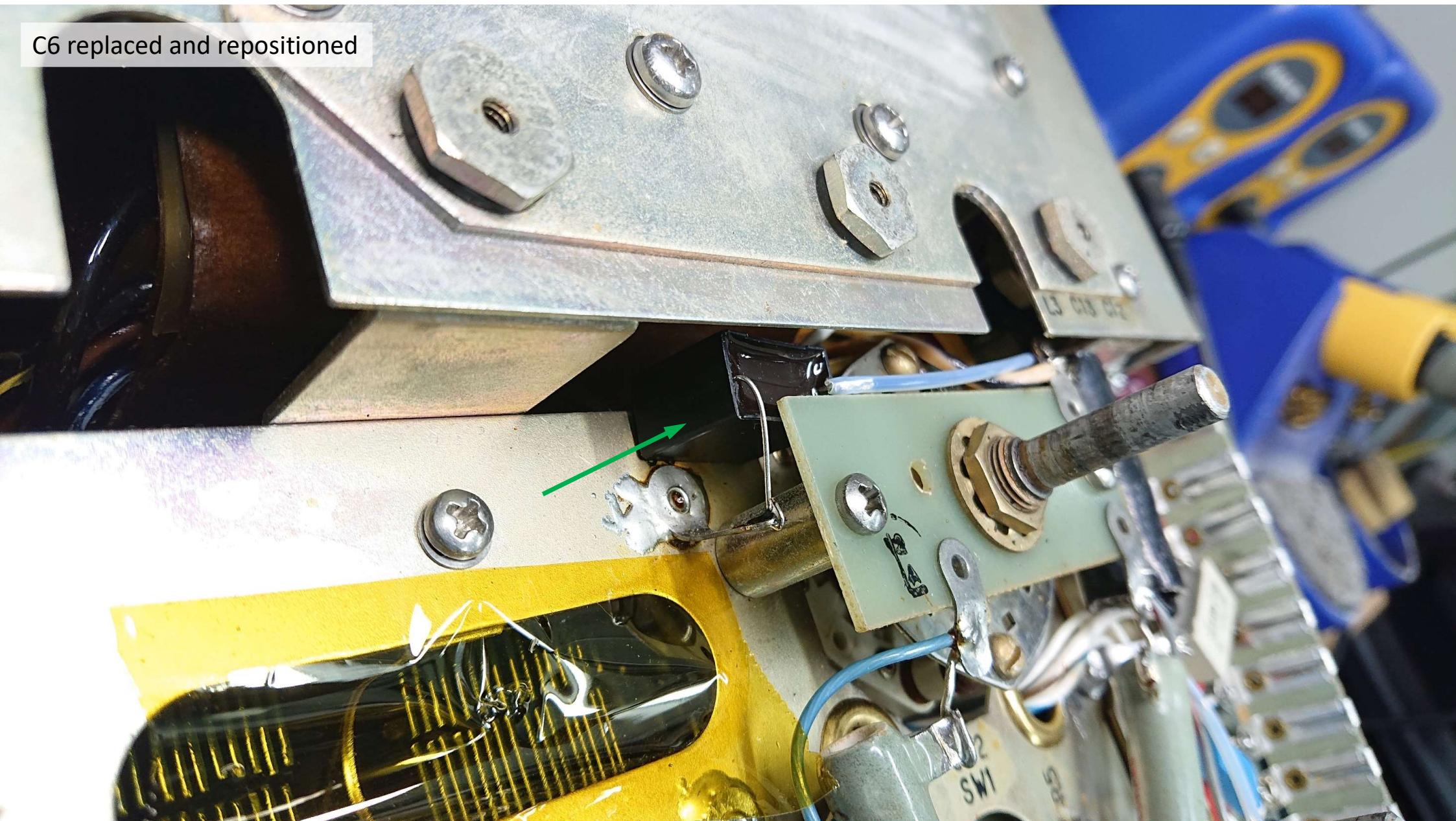
C1/C2 and L4 removed from chassis, L4 measured 3uH at 100KHz



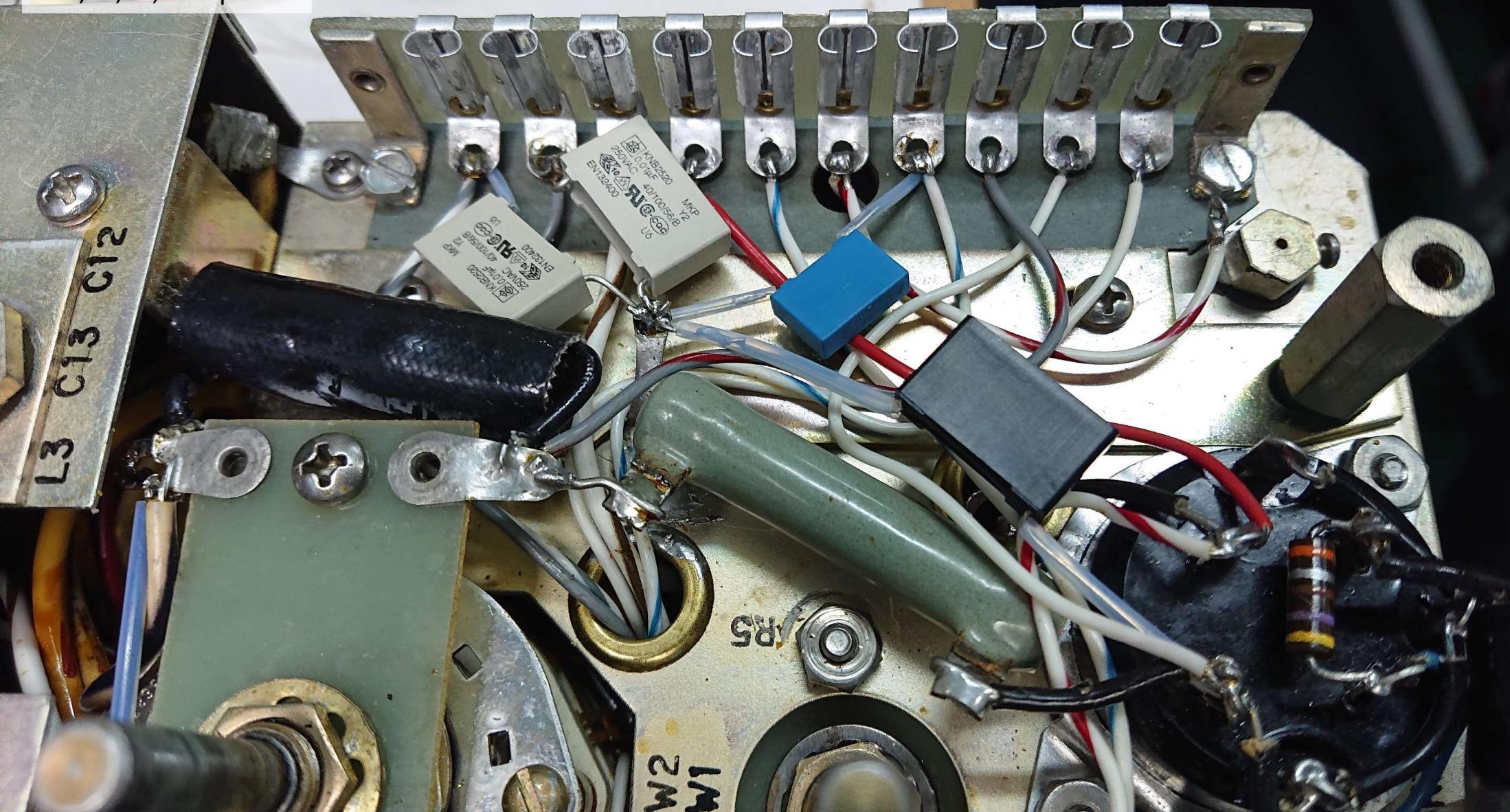
C1/C2 Replaced



C6 replaced and repositioned



C10,11,12,13 replaced



Refilling C4/C5/C7



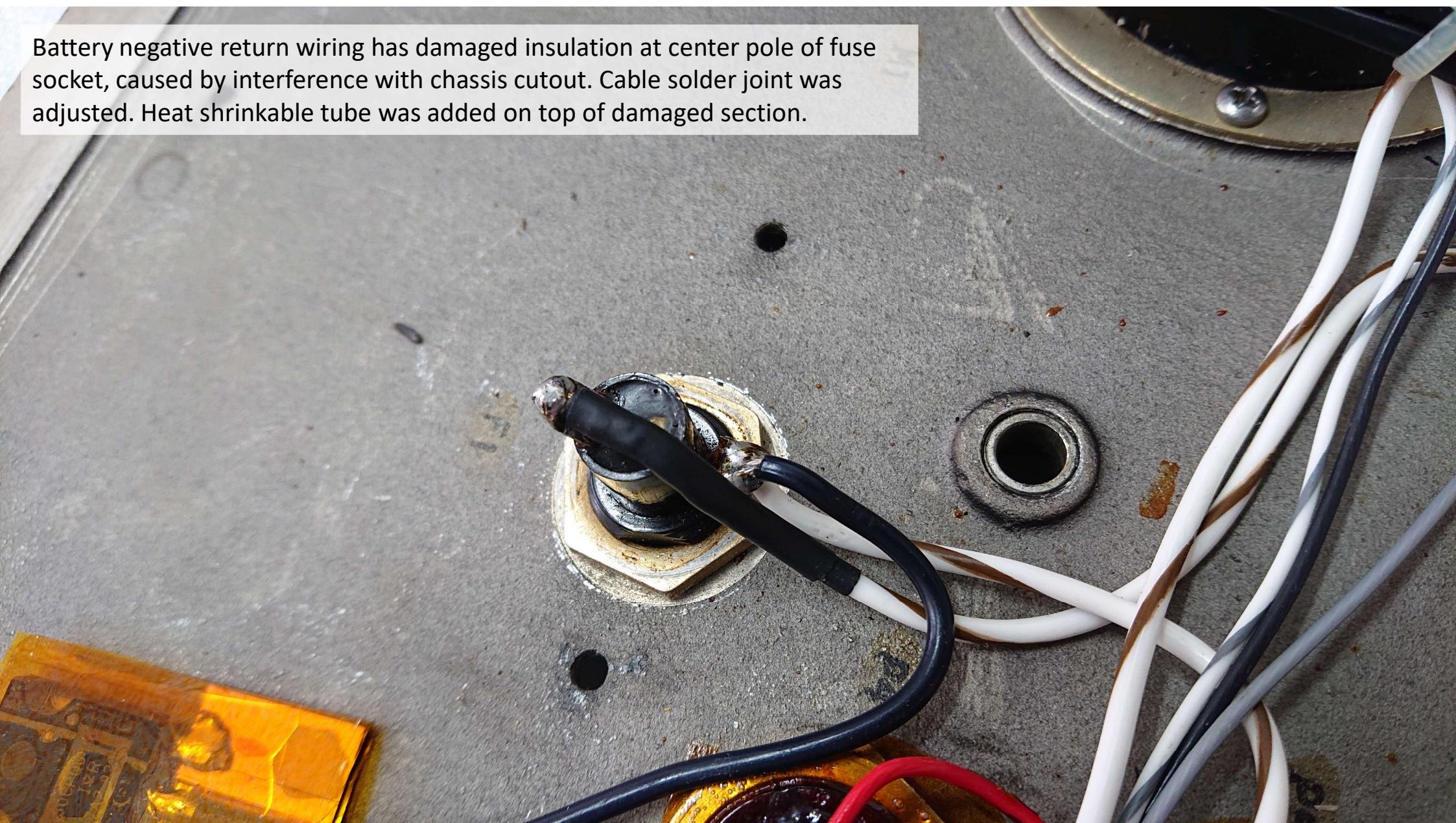
C4/C5/C7 refilled, re-sealed



C4/C5/C7 installation C4 housing has high voltage DC potential, must be insulated
C5,C7 housing too close to wafer switch, also need insulation
New C8,C9 can be seen at two corners, size much smaller than old component

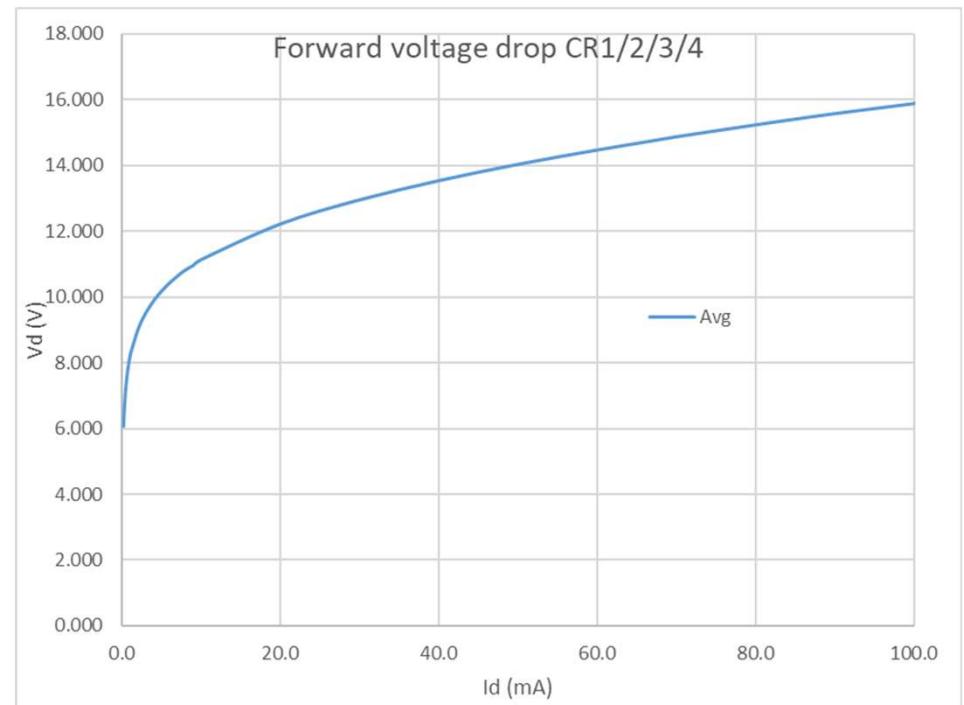
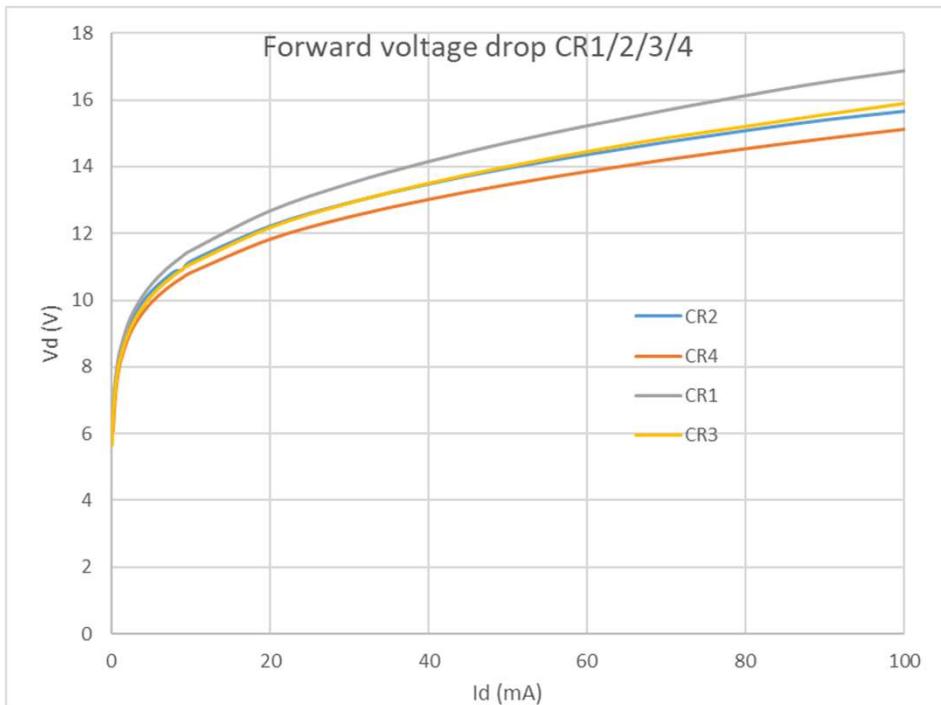


Battery negative return wiring has damaged insulation at center pole of fuse socket, caused by interference with chassis cutout. Cable solder joint was adjusted. Heat shrinkable tube was added on top of damaged section.



High voltage Selenium rectifier characteristic

- Diode voltage drop 6V (130uA), 15.8V(100mA) total 16 stacks in series
- Single plate voltage drop 0.99V(100mA)
- Dynamic resistance 45.6Ω (20mA to 100mA)

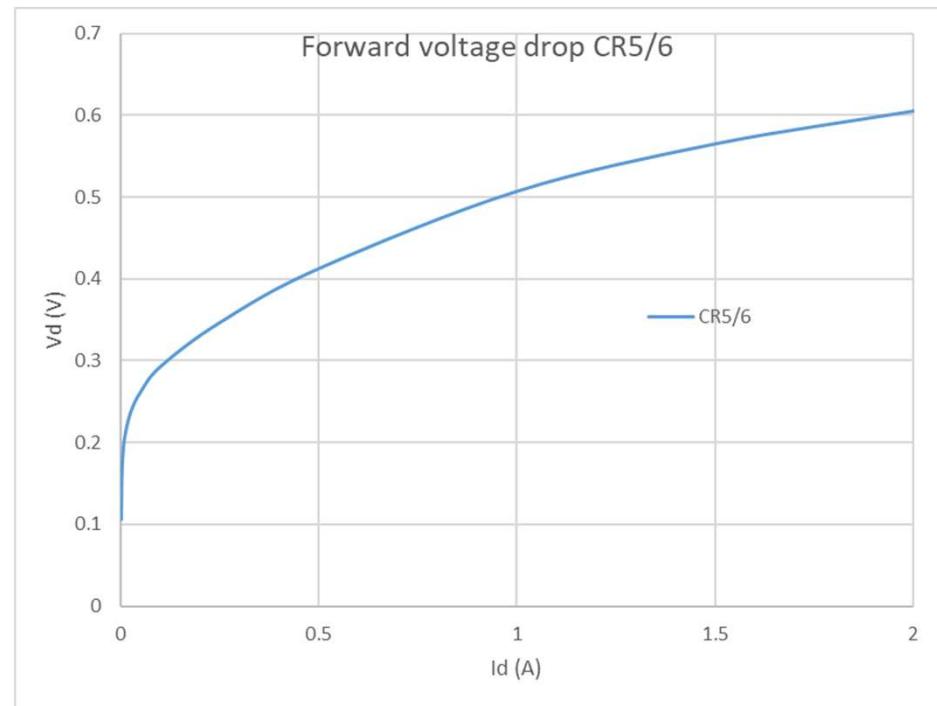


Replacing rectifier with common Silicon device such as 1N4007

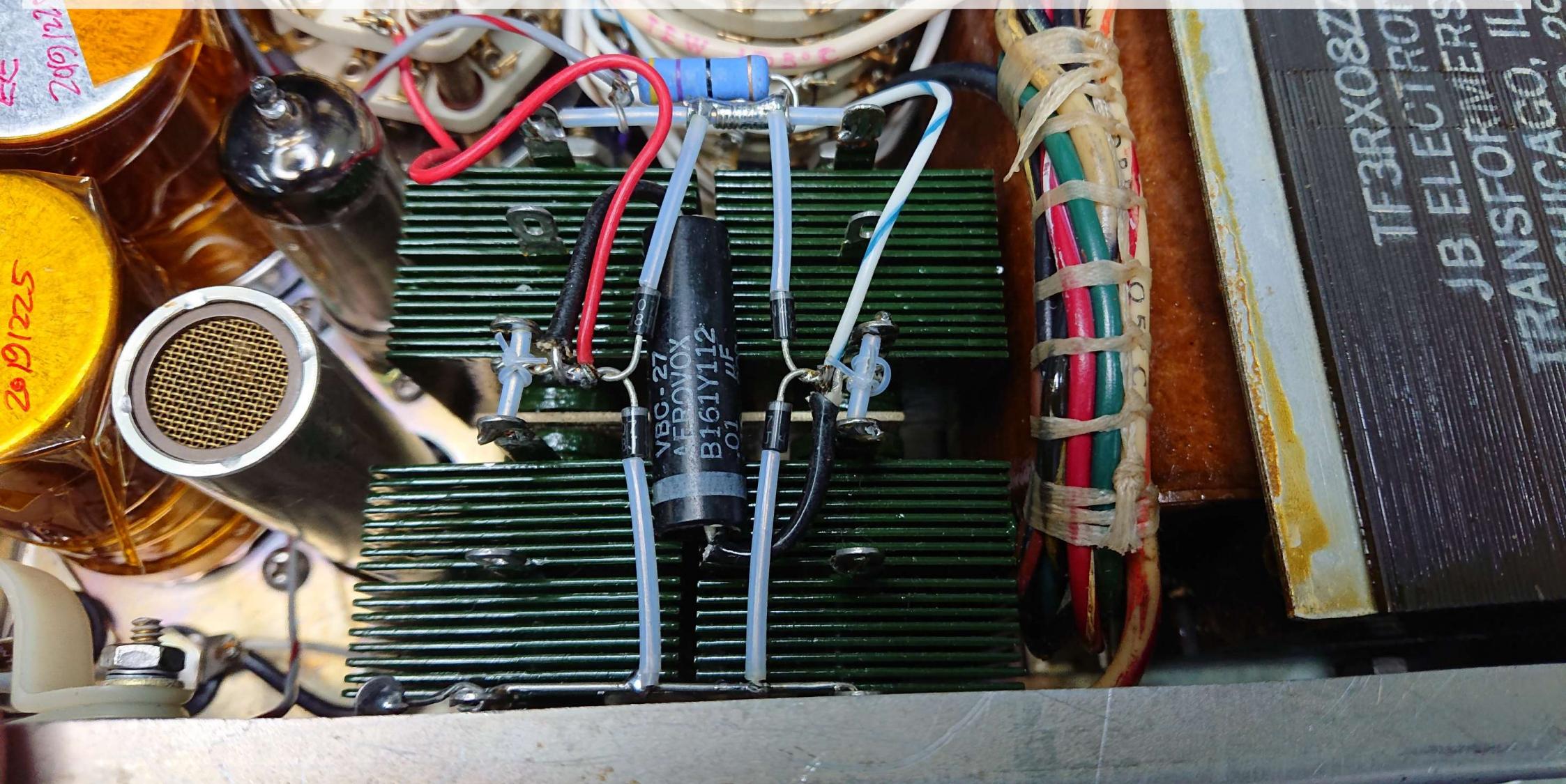
- Requires series resistance, starts with original dynamic resistance (45Ω) as starting point of adjustment
- Apply 50% derating rule for this resistor ($2x$ of $0.45W$)
- Expect increase in output voltage at open-circuit

Low voltage Selenium rectifier characteristic, battery charging section

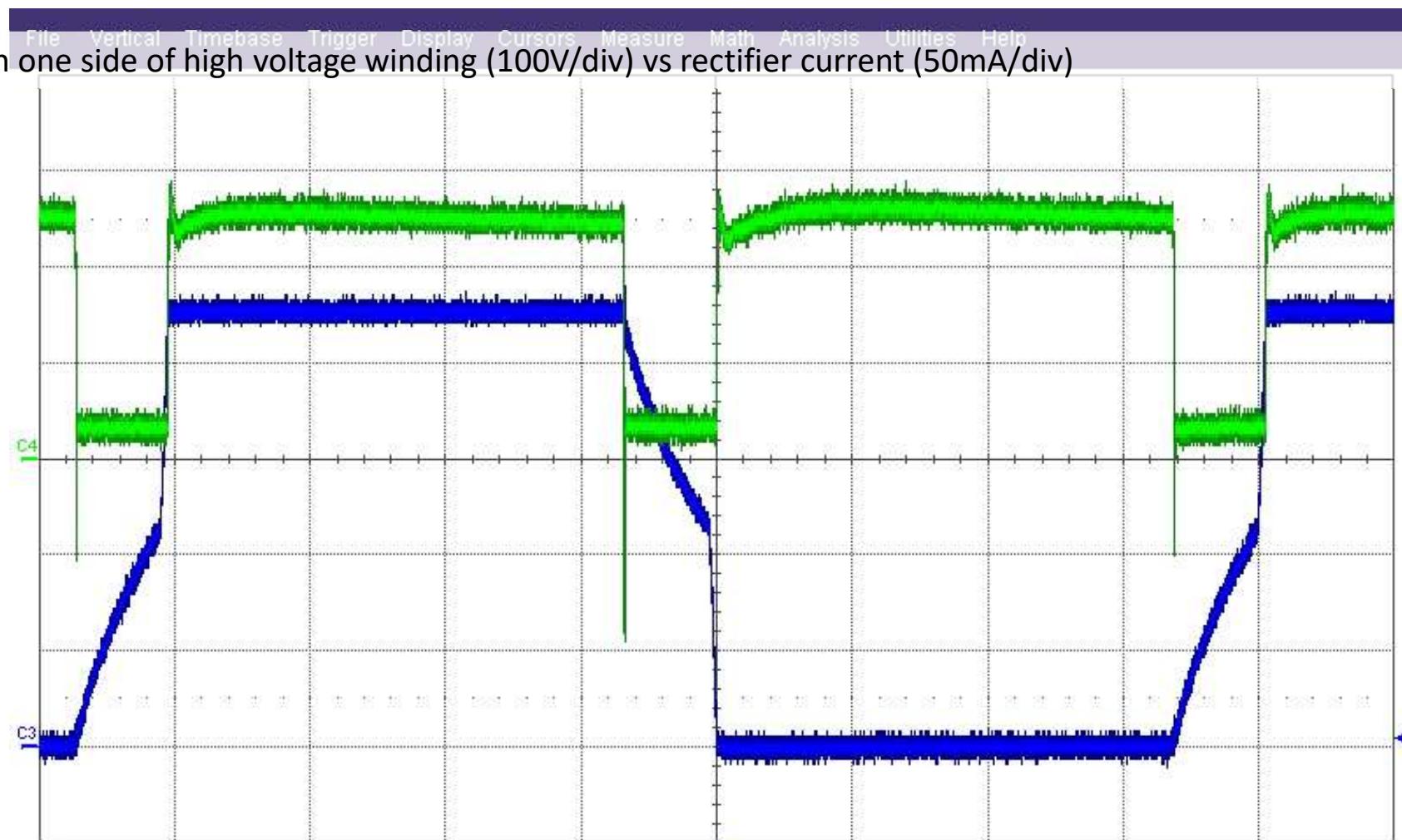
- Diode voltage drop 0.1V (360uA), 0.6V(2A) 1 stacks
- Dynamic resistance 0.128Ω (0.5A to 2A)



Replaced CR1/2/3/4 with 1N4007, a 47Ω 2W resistor is inserted to emulate Selenium part series resistance. Parts were piggybacked onto original wiring for support. Original CR1/2/3/4 are effectively isolated from circuit with insulation.



Waveform on one side of high voltage winding (100V/div) vs rectifier current (50mA/div)



Measure	P1:freq(C1)	P2:---	P3:---	P4:freq(C1)	P5:---	P6:---
value	445.14119 Hz					
status	IR					

C1 100 V/div	C4 BwL DC	C2 100.0 mA/div	C3 50.0 mA/div	C5 0.0 mA ofst	C6 0.0 mA ofst
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Timebase 0.00 ms	Trigger C3
1.00 ms/div	Auto
100 kS	8 V
10 MS/s	Edge
	Negative

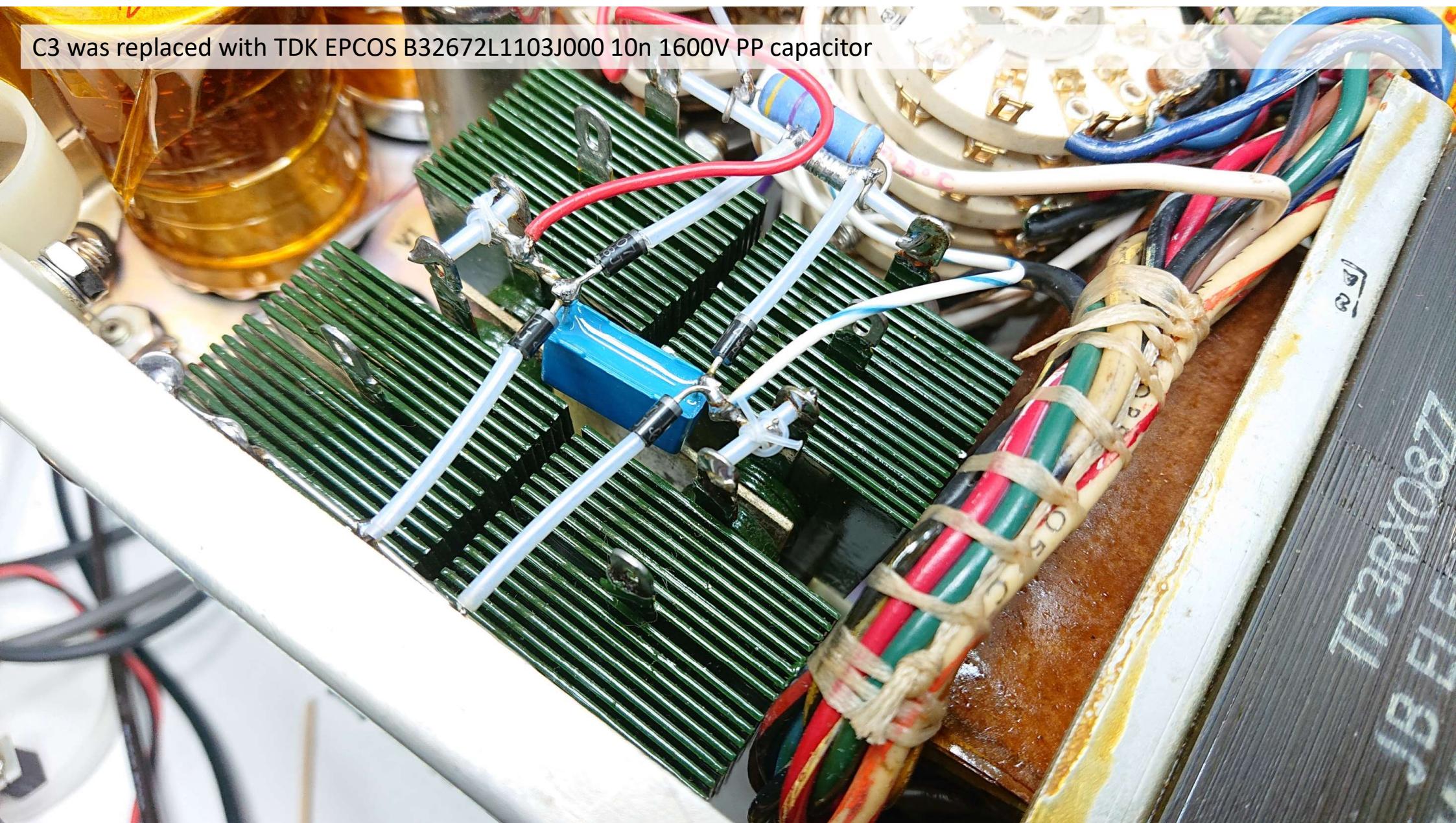
LeCroy

12/30/2019 1:56:35 PM

Added two series connected 1N4007 diode in parallel with CR7/8 as filament shunt regulator, new diodes provide ~1.6V voltage drop, original Selenium part not removed.



C3 was replaced with TDK EPCOS B32672L1103J000 10n 1600V PP capacitor



Fuse holder replaced with Littlefuse 03420006Z waterproof type 15mm hole size, original holder overheated causing fuse to blow under prolonged operation

